

PRELIMINARY DATA SUMMARY

November 1987

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

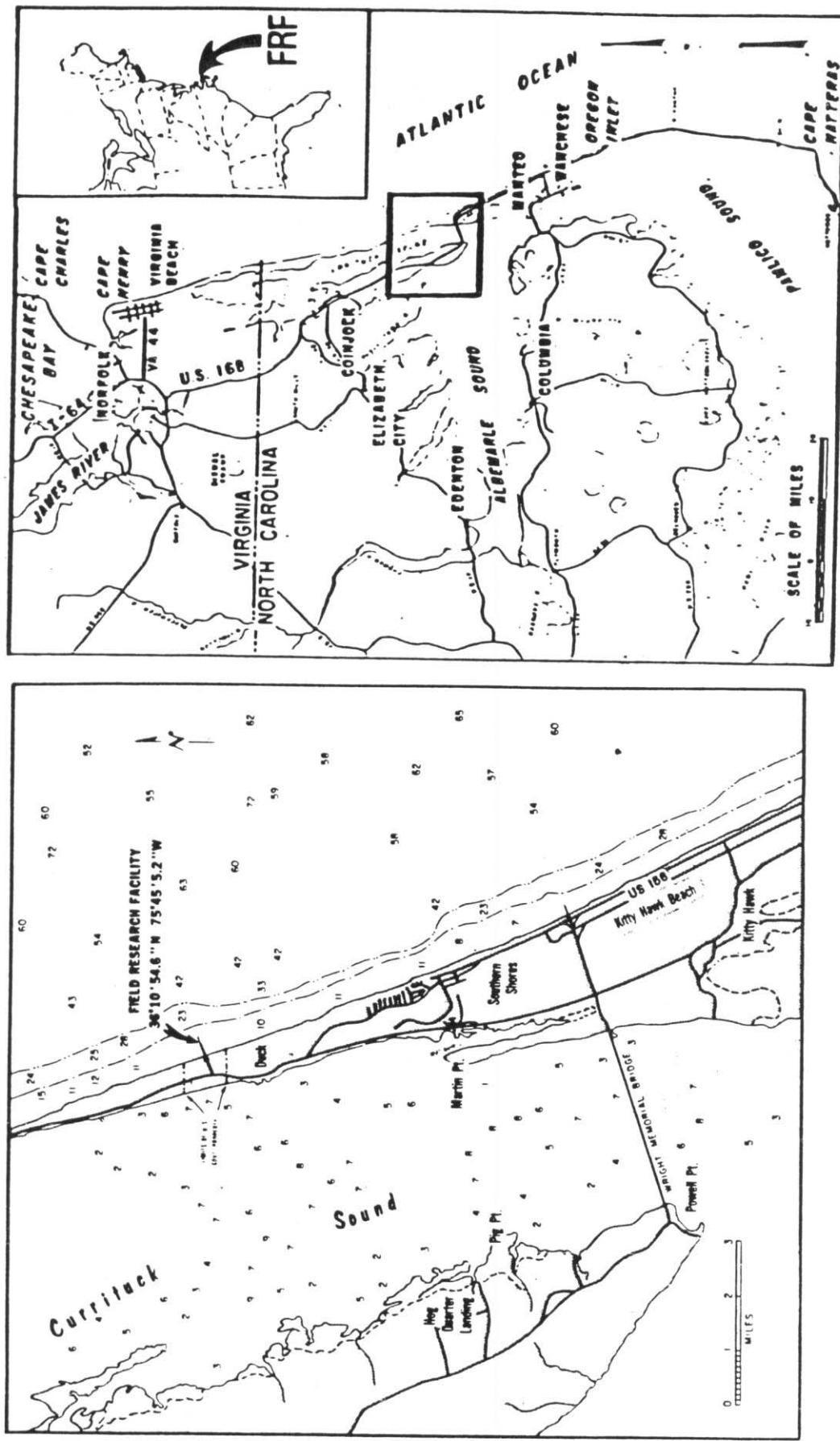


Figure 1. FRF location map.

TABLE 1: INSTRUMENT STATUS/DATA AVAILABILITY

NOV 1987

Gage ID	Description/Remarks	Depth at Sensor	Day of the month																													
			1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
624	Air Temperature		Gage Status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
632	Anemometer on Laboratory Building Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
625	Baylor staff at station 19+00 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
630	Waverider buoy 6.0 km offshore	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
679	Current meter 500 m south of FRF pier (0.5 km offshore)	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Supplemental Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

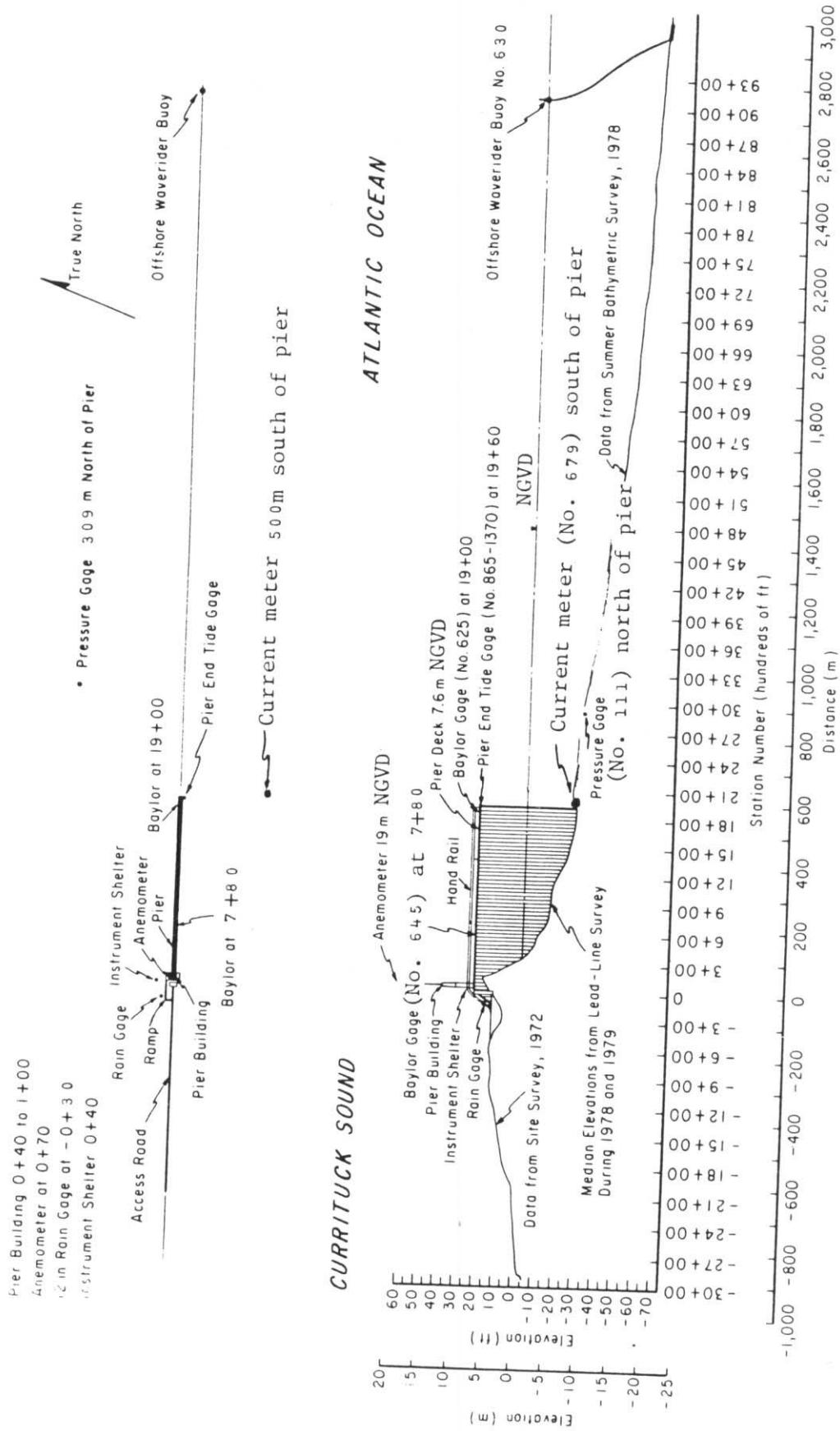


Figure 2. Instrument locations at FRF

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured on top of the laboratory building at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -
 $mm \times .03937 = in$
2. Millibars (mb) to inches of mercury (in Hg) -
 $mb \times 0.02953 = in Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

TABLE 2: Meteorological Data

NOV 1987

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	8	60	15.4	1031.1	0
	700	6	37	15.4	1031.1	0
	1300	7	22	16.2	1030.1	0
	1900	6	39	15.2	1029.4	0
2	100	7	38	15.0	1027.4	0
	700	7	40	15.4	1028.4	0
	1300	7	30	16.9	1027.4	0
	1900	5	41	15.9	1027.0	0
3	100	5	75	15.9	1026.0	0
	700	2	44	16.0	1025.7	0
	1300	3	93	19.5	1022.6	0
	1900	3	45	16.1	1020.9	0
4	100	3	24	16.1	1018.6	0
	700	3	3	16.4	1017.9	0
	1300	3	8	23.0	1014.5	0
	1900	3	73	19.4	1012.5	0
5	100	3	98	18.1	1009.4	0
	700	2	70	17.7	1006.4	0
	1300	4	99	22.9	1004.0	0
	1900	12	4	15.9	1010.1	0
6	100	7	32	11.8	1015.9	0
	700	7	28	9.1	1021.3	0
	1300	4	23	12.3	1022.6	0
	1900	2	10	8.4	1024.7	0
7	100	4	35	10.5	1025.7	0
	700	4	100	8.3	1027.0	0
	1300	5	35	15.7	1025.3	0
	1900	5	9	13.6	1025.0	0
8	100	6	27	12.8	1026.3	0
	700	5	15	12.1	1027.0	0
	1300	3	7	19.9	1025.7	0
	1900	5	81	15.8	1025.7	0
9	100	4	91	14.9	1025.0	0
	700	4	86	16.2	1024.7	0
	1300	3	2	22.8	1022.3	0
	1900	4	78	18.8	1021.6	0
10	100	5	87	18.9	1019.9	0
	700	4	44	17.2	1017.5	0
	1300	5	60	20.6	1011.1	0
	1900	9	16	12.8	1009.1	4
11	100	14	54	9.6	1011.1	0
	700	10	25	12.2	1008.7	7
	1300	11	4	5.3	1005.0	0
	1900	14	89	1.2	1008.7	0
12	100	11	99	1.5	1013.1	0
	700	9	8	1.4	1016.9	0
	1300	6	72	8.0	1016.5	0
	1900	5	57	8.1	1017.5	0
13	100	4	22	7.0	1017.5	0
	700	3	37	7.0	1018.6	0
	1300	6	37	13.4	1017.2	0
	1900	4	84	11.0	1017.5	0
14	100	4	10	9.7	1017.9	0
	700	5	24	9.4	1020.3	0
	1300	3	25	16.9	1020.3	0
	1900	2	32	11.1	1022.3	0
15	100	3	46	8.6	1024.7	0
	700	7	51	14.3	1028.4	0
	1300	6	35	15.9	1030.4	0
	1900	7	50	14.4	1031.1	0
16	100	5	56	14.4	1031.4	0
	700	6	57	14.3	1032.1	0
	1300	7	80	16.4	1031.4	0
	1900	8	94	15.2	1030.4	0

(Continued)

(Sheet 1 of 2)

TABLE 2: Meteorological Data

NOV 1987

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	mb	mm
17	100	4	37	14.2	1029.7	0
	700					
	1300	7	40	20.1	1023.6	0
	1900	7	74	20.4	1021.9	0
18	100	7	81	19.5	1018.2	0
	700	3	17	17.4	1019.9	8
	1300	5	34	17.0	1020.3	0
	1900	4	21	15.4	1022.3	0
19	100	6	38	12.6	1023.3	0
	700	11	38	12.2	1026.0	0
	1300	6	41	12.1	1023.0	0
	1900	5	49	12.5	1019.2	0
20	100	7	37	12.2	1012.5	5
	700	3	100	9.0	1009.8	0
	1300	6	92	13.4	1005.7	0
	1900	7	7	8.4	1007.7	0
21	100	11	23	4.1	1009.8	0
	700	12	94	1.0	1014.8	0
	1300	10	97	3.3	1016.2	0
	1900	9	17	1.6	1020.9	0
22	100	8	8	-0.7	1023.3	0
	700	6	16	-1.4	1026.7	0
	1300	5	18	4.0	1027.4	0
	1900	1	97	1.6	1028.0	0
23	100	3	14	3.2	1028.4	0
	700	3	71	3.7	1029.7	0
	1300	4	91	11.9	1029.1	0
	1900	4	84	10.3	1028.7	0
24	100	4	8	10.1	1029.7	0
	700	4	94	10.9	1031.1	0
	1300	4	95	19.7	1029.4	0
	1900	4	86	14.9	1029.4	0
25	100	3	77	13.0	1029.4	0
	700	3	8	12.6	1029.1	0
	1300	3	27	16.5	1027.0	0
	1900	3	23	13.7	1026.0	0
26	100	1	61	12.7	1025.0	0
	700	4	74	15.2	1024.3	0
	1300	3	57	16.9	1022.6	0
	1900	3	0	13.9	1022.6	0
27	100	2	44	14.2	1022.6	0
	700	10	48	12.9	1024.3	0
	1300	11	49	13.1	1023.0	3
	1900	12	46	13.2	1023.0	0
28	100	11	56	13.8	1020.9	4
	700	10	57	13.9	1020.3	10
	1300	10	62	14.1	1017.9	4
	1900	7	67	14.1	1016.9	0
29	100	7	90	14.2	1013.8	0
	700	4	18	14.0	1011.4	0
	1300	5	43	15.1	1006.7	9
	1900	4	19	13.9	1005.4	0
30	100	4	3	16.0	1002.0	4
	700	3	7	11.6	1002.0	0
	1300	7	52	12.3	999.6	0
	1900	6	57	11.3	1000.6	0
		Resultant 5	47	Mean 12.8	Mean 1020.6	Total 58

(Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs (more frequently during storms) near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

NOV 1987

		645		625		111		630	
Day	Hour	Baylor at 7+80 Hmo,m	T,sec	Baylor at 19+00 Hmo,m	T,sec	Hmo,m	T,sec	Farshr Hmo,m	Wvldr T,sec
1	0100	0.67	4.34	0.84	4.57	0.80	4.57	0.96	4.49
	0700	0.64	4.57	0.79	9.48	0.76	9.14	0.93	9.48
	1300	0.59	4.41	0.82	9.14	0.74	8.83	0.95	8.53
	1900	0.57	9.48	0.76	8.83	0.75	8.83	0.94	9.14
2	0100	0.59	14.22	0.84	8.53	0.74	9.14	0.97	8.83
	0700	0.63	14.22	0.85	8.83	0.75	8.83	0.92	8.83
	1300	0.71	14.22	0.94	14.22	0.87	13.47	1.04	13.47
	1900	0.62	12.80	0.89	8.83	0.85	8.83	0.99	13.47
3	0100	0.67	13.47	0.99	6.92	0.93	12.80	1.16	6.56
	0700	0.60	5.22	0.97	6.40	0.91	7.53	1.10	7.11
	1300	0.57	12.80	0.81	6.74	0.79	6.92	0.94	6.40
	1900	0.46	5.57	0.73	7.31	0.71	6.74	0.94	7.11
4	0100	0.44	8.00	0.71	6.74	0.68	7.76	0.88	6.92
	0700	0.42	9.14	0.64	7.31	0.67	8.26	0.80	7.53
	1300	0.37	8.00	0.56	8.00	0.57	8.00	0.73	7.76
	1900	0.31	8.53	0.58	9.14	0.54	8.53	0.71	7.31
5	0100	0.30	8.53	0.45	8.83	0.50	7.76	0.61	8.00
	0700	0.32	8.26	0.50	8.83	0.53	8.53	0.64	7.76
	1300	0.30	7.53	0.48	7.53	0.50	7.76	0.75	8.00
	1900	1.20	5.33	1.35	5.22	1.41	5.33	1.75	5.22
6	0100	1.30	6.09	1.48	6.56	1.51	6.40	1.86	6.24
	0700	1.72	6.92	1.70	7.31	1.66	6.74	1.93	6.56
	1300	1.00	6.92	0.98	7.53	0.95	6.74	1.24	7.11
	1900	0.72	5.33	0.77	5.95	0.71	5.22	0.99	6.09
7	0100	0.48	6.24	0.49	6.74	0.49	6.74	0.56	6.09
	0700	0.33	5.82	0.37	6.09	0.33	6.09	0.45	6.09
	1300	0.23	5.12	0.29	8.83	0.29	8.83	0.35	9.48
	1900	0.27	6.09	0.33	8.83	0.29	8.00	0.46	8.53
8	0100	0.15	11.13	0.23	9.48	0.24	8.83	0.37	8.83
	0700	0.12	8.00	0.21	8.26	0.21	7.76	0.31	7.76
	1300	0.15	12.80	0.19	8.26	0.22	8.26	0.26	8.53
	1900	*	*	0.31	7.76	0.27	3.37	0.44	3.28
9	0100	0.23	2.64	0.24	8.26	0.24	8.26	0.34	7.53
	0700	0.17	3.56	0.26	7.53	0.29	3.37	0.38	3.71
	1300	0.22	4.57	0.35	4.83	0.37	4.57	0.52	4.92
	1900	0.23	9.85	0.34	8.00	0.36	4.49	0.49	4.41
10	0100	0.22	8.00	0.36	4.66	0.37	7.53	0.52	4.74
	0700	0.27	7.31	0.47	7.53	0.47	8.00	0.60	7.31
	1300	0.30	7.11	0.53	6.92	0.48	7.11	0.66	6.92
	1900	0.42	7.76	0.80	6.56	0.77	6.24	1.21	6.74
11	0100	1.57	6.09	1.70	6.74	1.67	6.24	2.10	6.24
	0700	1.68	7.31	1.99	8.26	1.96	8.26	2.32	7.76
	1300	1.54	9.85	1.66	10.24	1.65	9.14	2.17	9.14
	1900	1.78	10.67	1.95	10.67	1.79	10.67	2.37	6.40
12	0100	1.92	9.85	2.25	10.24	2.19	10.67	2.72	10.24
	0700	1.57	10.67	2.22	10.67	2.03	10.67	2.41	9.85
	1300	1.57	10.67	1.62	10.67	1.47	10.67	1.65	8.83
	1900	0.80	10.24	0.98	10.67	1.05	10.67	1.02	10.24
13	0100	0.54	10.24	0.70	10.24	0.63	9.85	0.74	10.67
	0700	0.45	11.13	0.57	10.24	0.61	10.24	0.58	9.85
	1300	0.33	11.13	0.51	11.13	0.53	11.13	0.59	10.67
	1900	0.32	10.24	0.52	10.67	0.52	10.67	0.54	9.85
14	0100	0.30	10.67	0.51	10.24	0.46	10.24	0.47	9.85
	0700	0.23	10.24	0.37	10.24	0.37	10.24	0.45	9.48
	1300	0.18	9.14	0.30	9.85	0.32	9.85	0.40	9.85
	1900	0.18	9.14	0.29	9.48	0.30	9.14	0.37	8.83
15	0100	0.16	12.80	0.24	11.64	0.25	12.19	0.31	8.83
	0700	*	*	0.37	12.80	0.26	10.67	0.41	12.19
	1300	0.35	3.24	0.44	3.41	0.35	3.41	0.50	3.16
	1900	0.60	4.83	0.71	4.66	0.66	4.41	0.80	5.02
16	0100	0.79	5.57	0.95	5.33	0.89	5.69	1.02	5.33
	0700	0.66	5.45	0.87	6.09	0.82	5.45	1.00	5.95
	1300	0.59	5.02	0.85	5.22	0.79	5.57	0.93	5.12
	1900	0.51	5.33	0.78	5.22	0.71	5.22	0.90	5.22

* Electronic problems

(Continued)

(Sheet 1 of 2)

TABLE 3: WAVE DATA

NOV 1987

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo,m	T,sec 4.83	Baylor at 19+00 Hmo,m	T,sec 5.95	Pressure Gage Hmo,m	T,sec 5.82	Farshir Hmo,m	Wvrdr T,sec 6.24
17	0100	0.48		0.79		0.76		1.02	
	0700								
	1300	0.51	6.92	0.84	6.56	0.85	6.56	1.18	6.40
	1900	0.66	7.53	1.10	7.11	1.05	7.11	1.47	7.31
18	0100	0.68	7.31	1.12	7.53	1.13	7.31	1.54	6.92
	0700	0.78	8.83	1.26	8.53	1.23	8.83	1.75	8.53
	1300	0.68	8.26	1.07	8.83	1.11	8.83	1.41	8.53
	1900	0.50	8.53	0.83	8.53	0.81	8.53	1.04	8.26
19	0100	0.49	8.26	0.75	8.26	0.86	8.53	0.99	8.26
	0700	1.23	5.57	1.56	5.45	1.54	5.57	1.75	5.57
	1300	0.84	5.95	1.13	5.95	1.05	5.33	1.37	5.69
	1900	0.73	5.57	0.94	5.95	0.94	5.69	1.10	5.57
20	0100	0.70	5.82	0.96	4.00	0.92	3.88	1.08	8.26
	0700	0.56	4.57	0.73	4.74	0.74	4.66	0.83	7.31
	1300	0.33	12.19	0.52	12.19	0.51	12.80	0.62	6.92
	1900	0.65	4.57	0.75	4.49	0.81	4.27	1.17	4.49
21	0100	1.13	5.95	1.29	5.57	1.24	5.69	1.98	6.09
	0700	1.19	6.40	1.11	5.95	1.10	6.24	1.71	6.40
	1300	0.96	6.40	1.03	6.40	1.00	6.56	1.50	5.82
	1900	1.39	6.92	1.31	7.31	1.32	7.31	1.76	7.11
22	0100	1.06	6.40	1.36	6.40	1.39	6.09	1.95	6.40
	0700	1.28	6.09	1.24	8.00	1.16	7.76	1.68	7.76
	1300	0.89	6.92	1.03	7.31	0.96	7.76	1.40	8.26
	1900	0.86	6.92	0.87	6.74	0.78	6.92	1.09	6.56
23	0100	0.67	5.69	0.58	6.56	0.58	6.56	0.75	6.56
	0700	0.43	6.40	0.52	6.92	0.49	6.74	0.58	6.09
	1300	0.30	5.82	0.43	6.40	0.40	11.13	0.48	6.40
	1900	0.26	4.92	0.43	8.53	0.39	10.67	0.51	6.40
24	0100	0.17	13.47	0.35	8.83	0.35	8.83	0.38	8.83
	0700	0.17	9.14	0.34	8.83	0.35	9.14	0.41	8.53
	1300	0.19	9.85	0.31	8.83	0.34	8.83	0.36	8.53
	1900	0.17	12.19	0.31	9.85	0.32	9.48	0.37	8.00
25	0100	0.18	12.19	0.30	12.19	0.30	8.00	0.36	12.80
	0700	0.16	12.19	0.31	11.64	0.31	8.83	0.35	8.53
	1300	0.19	11.64	0.32	12.80	0.33	12.80	0.38	12.19
	1900	0.23	12.19	0.40	12.19	0.37	12.19	0.48	4.20
26	0100	0.31	5.33	0.56	5.33	0.55	12.19	0.73	5.45
	0700	0.42	5.57	0.75	8.26	0.77	7.11	1.08	6.24
	1300	0.48	10.67	0.78	8.83	0.81	8.83	1.11	6.92
	1900	0.39	11.13	0.77	10.67	0.81	8.53	1.01	10.24
27	0100	0.45	9.85	0.75	8.83	0.79	8.83	0.98	8.26
	0700	0.93	4.83	1.32	4.83	1.29	4.57	1.57	4.74
	1300	1.45	7.11	1.95	7.31	1.91	7.31	2.30	7.31
	1900	0.96	7.31	2.16	7.53	1.95	8.26	2.30	7.76
28	0100	1.29	8.00	1.97	8.53	1.79	9.14	2.10	8.26
	0700	1.01	8.00	1.84	8.00	1.79	7.76	2.05	7.53
	1300	1.32	8.00	1.96	7.53	1.70	7.31	2.17	8.26
	1900	1.09	7.76	1.91	8.26	1.85	8.26	2.06	7.76
29	0100	1.28	9.85	1.90	7.11	1.77	8.53	2.19	7.53
	0700	1.07	8.26	1.87	8.00	1.84	8.26	2.16	8.53
	1300	1.36	10.67	2.30	10.24	1.95	9.85	2.36	8.26
	1900	1.13	9.85	1.95	10.67	1.95	10.24	1.98	10.67
30	0100	1.16	9.14	1.76	9.14	1.58	9.48	1.94	9.14
	0700	0.89	9.48	1.49	8.26	1.33	8.83	1.50	8.53
	1300	0.95	11.64	1.54	10.67	1.41	11.13	1.81	9.48
	1900	1.04	11.64	1.63	10.67	1.48	11.64	1.84	11.64
	Mean	0.67	8.17	0.92	8.08	0.88	8.05	1.10	7.64
	Std dev	0.44	2.73	0.55	2.11	0.52	2.21	0.63	2.01

* Electronic problems

(Sheet 2 of 2)

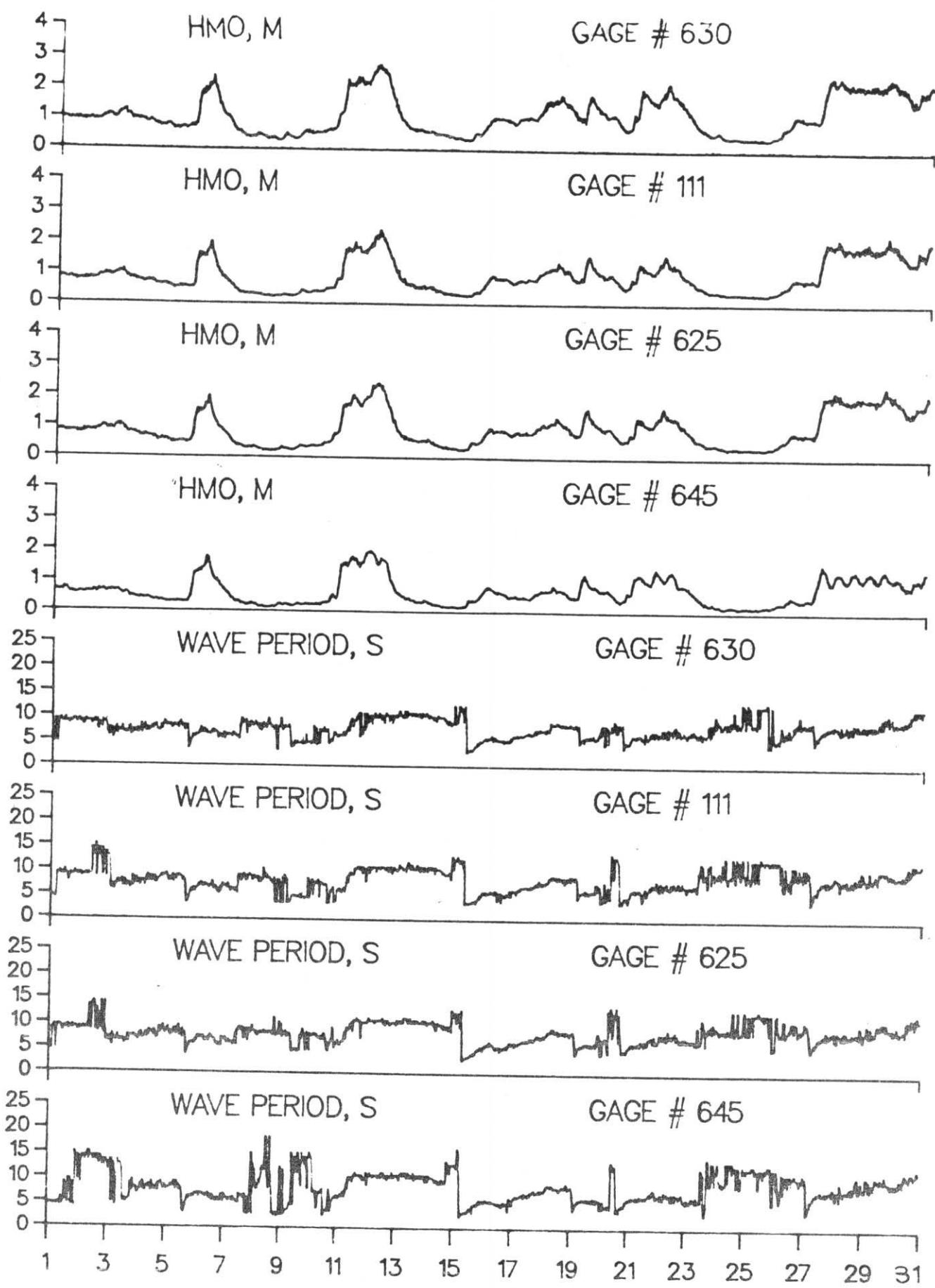


FIGURE 3. Time History of Wave Heights and Periods - November 1987

PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

TABLE 4: Current Data
NOV 1987

Day	Time	Pier Measurements				Beach Measurements			Current Meter	
		Alongshore Cross-shore Resultant Dye at (579 m) (surface)	Cross Result Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
1	0100-Along								7	S
	Cross								1	off
	Result								7	152
1	0700-Along	14	S		30	S		49 N	14	S
	Cross	4	on	238	37	off	North		2	off
	Result	14	177		48	110			14	152
1	1300-Along								3	S
	Cross								0	
	Result								3	160
1	1900-Along								14	S
	Cross								2	off
	Result								14	152
2	0100-Along								10	S
	Cross								0	
	Result								10	160
2	0700-Along	29	S		9	S		30 N	14	S
	Cross	12	on	226	7	off	North		2	off
	Result	31	182		12	123			14	152
2	1300-Along								5	S
	Cross								1	off
	Result								5	149
2	1900-Along								14	S
	Cross								3	off
	Result								14	148
3	0100-Along								12	S
	Cross								6	off
	Result								13	133
3	0700-Along	28	S		68	N		30	16	S
	Cross	0		140	14	off	South		6	off
	Result	28	160		69	351			17	139
3	1300-Along								3	N
	Cross								1	on
	Result								3	322
3	1900-Along								2	S
	Cross								2	on
	Result								3	205
4	0100-Along								3	N
	Cross								1	on
	Result								3	322
4	0700-Along	15	N		61	N		17 N	5	N
	Cross	7	off	140	6	off	South		1	on
	Result	17	7		61	346			5	329
4	1300-Along								13	N
	Cross								3	on
	Result								13	327
4	1900-Along								9	N
	Cross								5	on
	Result								10	311
5	0100-Along								10	N
	Cross								4	on
	Result								11	318
5	0700-Along	2	N		41	N		4	6	N
	Cross	6	off	140	0		South		4	on
	Result	6	49		41	340			7	306
5	1300-Along								6	N
	Cross								4	on
	Result								7	306
5	1900-Along								28	S
	Cross								2	off
	Result								28	156

KEY = All speeds in CM/SEC
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

TABLE 4: Current Data
NOV 1987

Day	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
	Alongshore Cross-shore Resultant		Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)		Location	Speed	Dir
Time	Speed	Dir	Distance from Baseline (m)	Speed	Dir	Speed	Dir				
6 0100-Along Cross Result										31	S
6 0700-Along Cross Result	61	S		61	S			94	S	28	S
	18	on	287	12	off			North		2	off
	64	177		62	149					28	156
6 1300-Along Cross Result										13	S
6 1900-Along Cross Result										2	off
										13	151
7 0100-Along Cross Result										1	S
7 0700-Along Cross Result	14	N		8	S			94		14	N
	5	off	128	2	off			North		1	on
	14	359		8	143					1	295
7 1300-Along Cross Result										11	N
7 1900-Along Cross Result										2	on
										11	330
8 0100-Along Cross Result										10	N
8 0700-Along Cross Result	3	N		7	N			13		1	on
	11	off	128	5	on			South		10	334
	12	57		9	303					7	324
8 1300-Along Cross Result										2	on
8 1900-Along Cross Result										7	327
8 0100-Along Cross Result										5	N
9 0700-Along Cross Result	29	N		8	N			11	N	3	on
	4	off	140	3	off			South		14	328
	29	349		8	2					4	N
9 1300-Along Cross Result										2	on
9 1900-Along Cross Result										4	313
10 0100-Along Cross Result										11	N
10 0700-Along Cross Result	23	N		30	N			9	N	3	on
	0	140		0				South		6	301
	23	340		30	340					7	N
10 1300-Along Cross Result										4	on
10 1900-Along Cross Result										6	250
										2	S
										2	on
										3	205

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data
NOV 1987

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements				Current Meter			
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	at South Tripod Depth -4.8m (NGVD) ID #679
Day												
11 0100-Along Cross Result										37	S	
11 0700-Along Cross Result	55 17 58	S off 143		287	87 13 88	S off 151		101	S	28 4 28	S off 152	
11 1300-Along Cross Result										34 2 34	S off 157	
11 1900-Along Cross Result										34 2 34	S on 163	
12 0100-Along Cross Result										36 0 36	S on 160	
12 0700-Along Cross Result	51 15 53	S off 143		299	68 3 68	S off 157		61	S	26 2 26	S on 164	
12 1300-Along Cross Result										11 1 11	S on 165	
12 1900-Along Cross Result										9 0 9	S on 160	
13 0100-Along Cross Result										3 2 4	S off 126	
13 0700-Along Cross Result	11 6 12	N off 11		165	29 17 34	N off 11		27	S	13 8 15	N on 308	
13 1300-Along Cross Result										10 5 11	N on 313	
13 1900-Along Cross Result										9 4 10	N on 316	
14 0100-Along Cross Result										7 4 8	N on 310	
14 0700-Along Cross Result	17 10 20	N off 11		165	20 4 21	N off 351		20	N	11 4 12	N on 320	
14 1300-Along Cross Result										13 4 14	N on 323	
14 1900-Along Cross Result										3 0 3	N on 340	
15 0100-Along Cross Result										5 1 5	S on 171	
15 0700-Along Cross Result	15 9 18	S on 191		152	24 0 24	N on 340		no observation		12 6 13	S off 133	
15 1300-Along Cross Result										7 8 11	S off 111	
15 1900-Along Cross Result										13 1 13	S off 156	

KEY = All speeds in CM/SEC
N = Northward, Shore parallel
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on = onshore off = offshore

TABLE 4: Current Data
NOV 1987

Day	Time	Pier Measurements				Beach Measurements			Current Meter at South Tripod	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	Depth -4.8m (NGVD)
16	0100-Along Cross Result									15 S off
16	0700-Along Cross Result	27 S on	140		17 N on				20 6	16 138
16	1300-Along Cross Result	13 187			8 19	316			21	143
16	1900-Along Cross Result								8 4 9	187
17	0100-Along Cross Result								11 1	S off
17	0700-Along Cross Result	8 N off	140		76 N on				11 3	155
17	1300-Along Cross Result	5 9			15 78	329			5 6	on 219
17	1900-Along Cross Result								1 2 2	223
18	0100-Along Cross Result								20 3	N on
18	0700-Along Cross Result	8 N off	152		102 0	N			20 32	331
18	1300-Along Cross Result	8 25			102	340			32 4	on 333
18	1900-Along Cross Result								32 12	328
19	0100-Along Cross Result								12 1	N on
19	0700-Along Cross Result	47 S on	152		68 S on				12 8	326
19	1300-Along Cross Result	14 177			34 76	187			18 4	off 147
19	1900-Along Cross Result								12 18	S 155
20	0100-Along Cross Result								10 2	off 149
20	0700-Along Cross Result	27 S off	140		9 5	N off			10 2	S off
20	1300-Along Cross Result	9 141			10	11			10 5	152
20	1900-Along Cross Result								0 5	S
									14 1	off 160
									14 14	156

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data
NOV 1987

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter at South Tripod			
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
21 0100-Along Cross Result											23	S
21 0700-Along Cross Result	76 15 78	S off 149			102 10 102	S off 154			no observation		19 1 19	S off 158
21 1300-Along Cross Result											20 0 20	S 160
21 1900-Along Cross Result											23 2 23	S off 155
22 0100-Along Cross Result											24 1 24	S off 158
22 0700-Along Cross Result	44 4 44	S on 166			207	61 46 76	S on 197		North	17	S	7 3 8
22 1300-Along Cross Result											5 1 5	S on 171
22 1900-Along Cross Result											8 2 8	N on 326
23 0100-Along Cross Result											6 1 6	N on 331
23 0700-Along Cross Result	23 9 24	N off 2			140	3 1 4	N off 354		South	14		10 5 11
23 1300-Along Cross Result											10 3 10	N on 323
23 1900-Along Cross Result											16 2 16	N on 333
24 0100-Along Cross Result											10 1 10	N on 334
24 0700-Along Cross Result	30 9 32	N off 357			140	0 152 152			South	18	N	16 3 16
24 1300-Along Cross Result											3 3 4	N on 295
24 1900-Along Cross Result											6 3 7	N on 313
25 0100-Along Cross Result											0 1 1	N on 250
25 0700-Along Cross Result	16 2 17	N off 346			140	10 2 10	N off 349		South	11	N	7 2 7
25 1300-Along Cross Result											2 1 2	S on 187
25 1900-Along Cross Result											1 2 2	N on 277

KEY = All speeds in CM/SEC
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on = onshore off = offshore

TABLE 4: Current Data
NOV 1987

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements			Current Meter at South Tripod	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		(500m Updrift)		Dye 12m offshore (surface) Location		Depth -4.8m (NGVD) ID #679	Speed	Dir
Day	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	
26 0100-Along Cross Result									7	S	
26 0700-Along Cross Result	12 4 13	N off 357	165	61 27 67	N on 316		19	N	2	off	
26 1300-Along Cross Result							North		7	144	
26 1900-Along Cross Result									5	N	
27 0100-Along Cross Result									1	on	
27 0700-Along Cross Result	19 29 34	S on 216	171	76 114 137	S on 216		no observation		5	329	
27 1300-Along Cross Result									4	N	
27 1900-Along Cross Result									0		
28 0100-Along Cross Result									4	340	
28 0700-Along Cross Result	16 5 16	S on 177	213	47 14 49	S on 177		no observation		0		
28 1300-Along Cross Result									3		
28 1900-Along Cross Result									27	340	
29 0100-Along Cross Result									7	S	
29 0700-Along Cross Result	16 1 16	N off 343	189	76 46 89	N on 309		26	N	1	off	
29 1300-Along Cross Result							North		12	151	
29 1900-Along Cross Result									19		
30 0100-Along Cross Result									19		
30 0700-Along Cross Result	9 3 9	S off 143	140	87 9 88	N on 334		91	N	3	S	
30 1300-Along Cross Result							South		0		
30 1900-Along Cross Result									3	250	

KEY = All speeds in CM/SEC
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves). The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5: Supplemental Observations

NOV 1987

DAY	TIME	WAVE APPROACH ANGLE AT PIER END		RADAR WAVE ANGLE deg from True N	WIDTH OF SURF ZONE,m	WATER CHARACTERISTICS AT PIER END		
		Primary	Secondary			TEMP,C	DENSITY g/cc	SECCI VIS,m
1	1032	80	30	inoperative	171	16.7	1.0226	2.1
2	747	80			91	16.9	1.0226	2.1
3	815	90	50		61	16.7	1.0226	2.1
4	724	90	60		30	16.7	1.0220	2.4
5	740	100	60		52	16.7	1.0226	1.5
6	725	50		60	128	15.0	1.0230	0.9
7	858	20	350		10	14.5	1.0232	1.2
8	945	none visible			6	15.6	1.0232	1.2
9	740	100	50		30	16.1	1.0230	3.0
10	800	100			24	16.4	1.0232	3.7
11	806	90	580	80	247	15.0	1.0236	0.6
13	830	50			329	12.2	1.0228	0.0
14	820	50			98	13.4	1.0224	0.6
14	1005	65	130	60	85	14.5	1.0234	0.9
15	850	60			80	14.5	1.0240	0.6
16	730	60		60	85	13.4	1.0216	1.2
17	700	90			79	13.9	1.0226	0.9
18	756	100			88	15.0	1.0232	0.9
19	720	50		50	85	14.2	1.0324	0.6
20	825	60	30		61	13.9	1.0232	1.2
21	904	50	20		63	10.6	1.0234	0.3
22	1140	10			101	8.9	1.0224	0.6
23	740	50			30	10.6	1.0226	0.9
24	750	100			18	12.2	1.0232	1.2
25	737	none visible			30	12.2	1.0232	2.1
26	1040	80	110	inoperative	98	13.9	1.0232	1.2
27	1100	30	10	inoperative	63	12.8	1.0234	4.6
28	1114	65	35	inoperative	120	12.8	1.0230	0.3
29	1130	80		inoperative	120	13.0	1.0220	0.3
30	800	90	50		189	12.2	1.0230	0.3

PART VI: WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours) and contains a list of selected mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

FRF TIDE HEIGHTS
NOV 1987

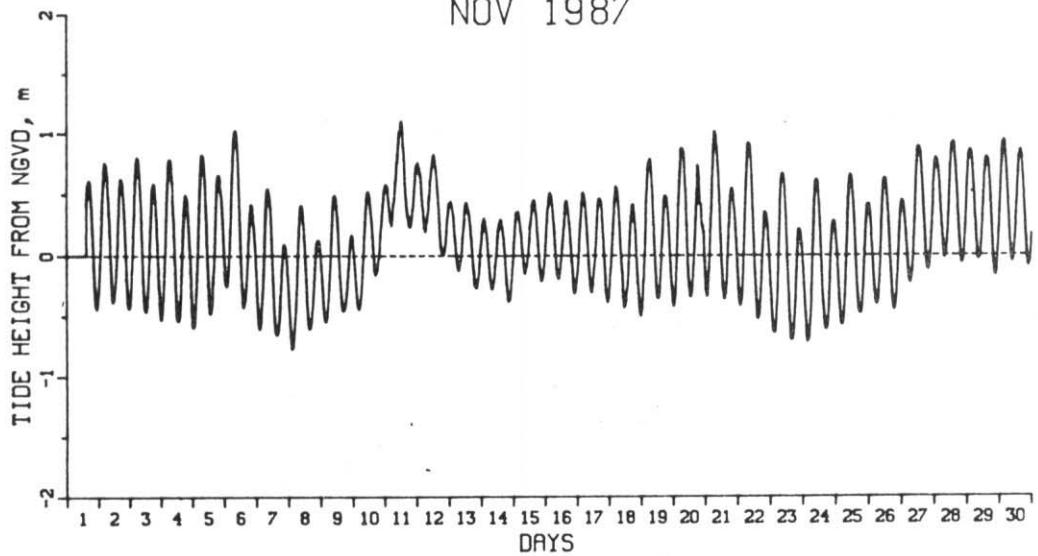


FIGURE 4. Time History of Mean Water Levels, November 1987

MONTHLY WATER LEVELS (METERS NGVD)

EXTREME LOW = -0.77 ON DAY 8 AT 230HRS.
EXTREME HIGH = 1.10 ON DAY 11 AT 1148HRS.
MONTHLY MEAN = 0.13
MEAN LOW = -0.35
MEAN HIGH = 0.66
MEAN RANGE = 1.01

Table 6: WATER LEVELS, METERS NGVD

MID-CYCLE DAY TIME		NOV 1987			
		LOW	HIGH	MEAN	RANGE
1	2018	-0.44	0.61	0.11	1.05
2	843	-0.38	0.76	0.18	1.14
2	2109	-0.44	0.63	0.11	1.06
3	934	-0.46	0.80	0.15	1.27
3	2159	-0.53	0.59	0.06	1.12
4	1024	-0.54	0.79	0.08	1.33
4	2249	-0.59	0.54	-0.01	1.13
5	1115	-0.48	0.83	0.16	1.30
5	2340	-0.26	0.81	0.26	1.06
6	1205	-0.43	1.02	0.25	1.45
7	30	-0.61	0.42	-0.09	1.02
7	1255	-0.66	0.55	-0.12	1.20
8	121	-0.77	0.25	-0.29	1.03
8	1346	-0.61	0.41	-0.14	1.02
9	211	-0.55	0.37	-0.16	0.92
9	1436	-0.46	0.49	-0.04	0.95
10	301	-0.44	0.36	-0.11	0.80
10	1527	-0.16	0.52	0.17	0.69
11	352	0.24	1.00	0.52	0.76
11	1617	0.23	1.10	0.59	0.87
12	442	0.20	0.77	0.51	0.58
12	1707	0.00	0.83	0.35	0.82
13	533	-0.12	0.44	0.17	0.57
13	1758	-0.27	0.44	0.05	0.71
14	623	-0.28	0.30	0.02	0.58
14	1848	-0.38	0.30	-0.03	0.68
15	713	-0.15	0.37	0.13	0.52
15	1938	-0.21	0.45	0.13	0.67
16	804	-0.20	0.51	0.15	0.71
16	2029	-0.31	0.45	0.07	0.76
17	854	-0.30	0.51	0.11	0.82
17	2119	-0.39	0.46	0.05	0.85
18	944	-0.43	0.56	0.05	0.99
18	2210	-0.50	0.69	0.02	1.19
19	1035	-0.35	0.79	0.18	1.14
19	2300	-0.42	0.83	0.12	1.25
20	1125	-0.34	0.87	0.23	1.21
20	2350	-0.34	0.91	0.23	1.25
21	1216	-0.36	1.01	0.26	1.37
22	41	-0.41	0.84	0.14	1.25
22	1306	-0.52	0.91	0.12	1.44
23	131	-0.64	0.62	-0.09	1.26
23	1356	-0.70	0.67	-0.09	1.37
24	222	-0.71	0.54	-0.18	1.26
24	1447	-0.61	0.62	-0.05	1.23
25	312	-0.57	0.58	-0.08	1.16
25	1537	-0.48	0.66	0.03	1.13
26	402	-0.40	0.51	0.04	0.91
26	1628	-0.45	0.63	0.07	1.08
27	453	-0.23	0.75	0.17	0.97
27	1718	-0.12	0.88	0.38	1.01
28	543	-0.02	0.79	0.42	0.81
28	1808	-0.06	0.92	0.43	0.99
29	634	-0.03	0.86	0.41	0.89
29	1859	-0.17	0.80	0.34	0.97
30	724	-0.05	0.94	0.43	0.99
30	1949	-0.09	0.86	0.38	0.95

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in September and the three surveys in November on profile line 188, located 517 m south of the pier. The most significant change during November was the substantial erosion (up to 0.75 m) to the foreshore (80 to 140 m). Further offshore, the nearshore bar (160 to 240 m) was repeatedly reshaped but showed little movement. A small amount of accretion is also visible on the shoreward face (280 to 360 m) of the storm bar.

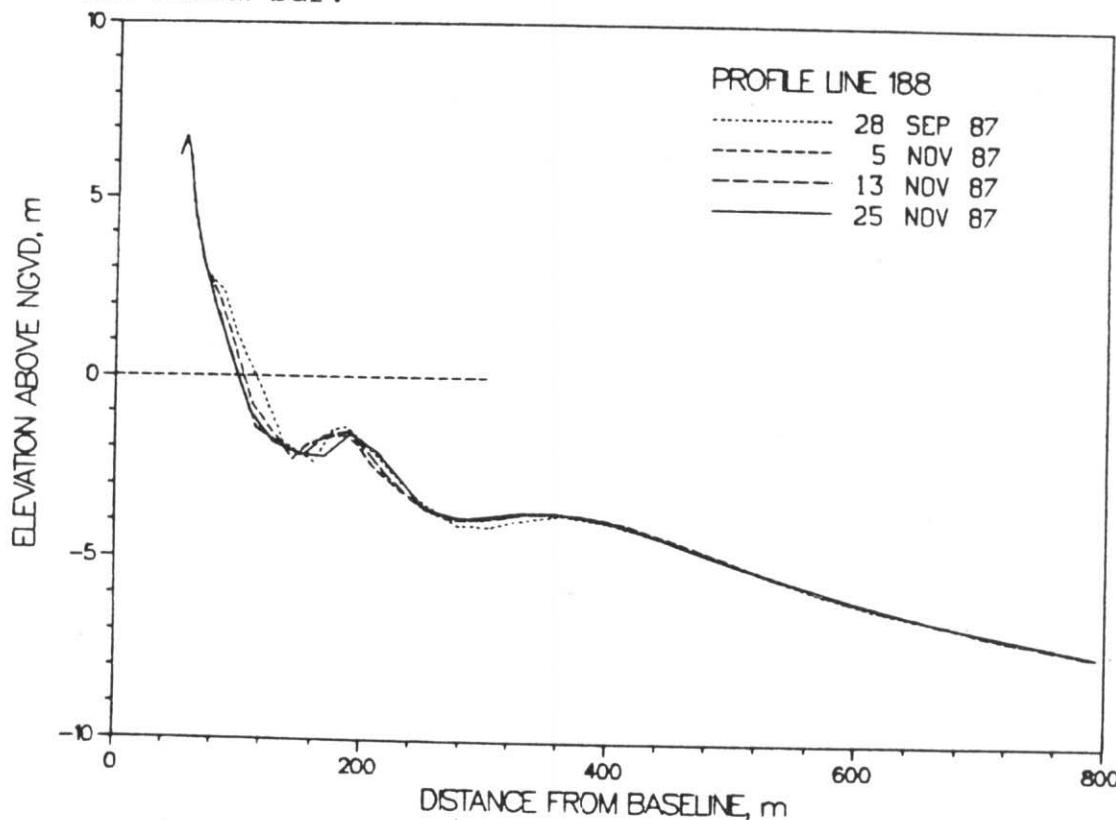


Figure 5. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1987. Only one minor change (320 to 360 m) is visible resulting from accretion on the storm bar.

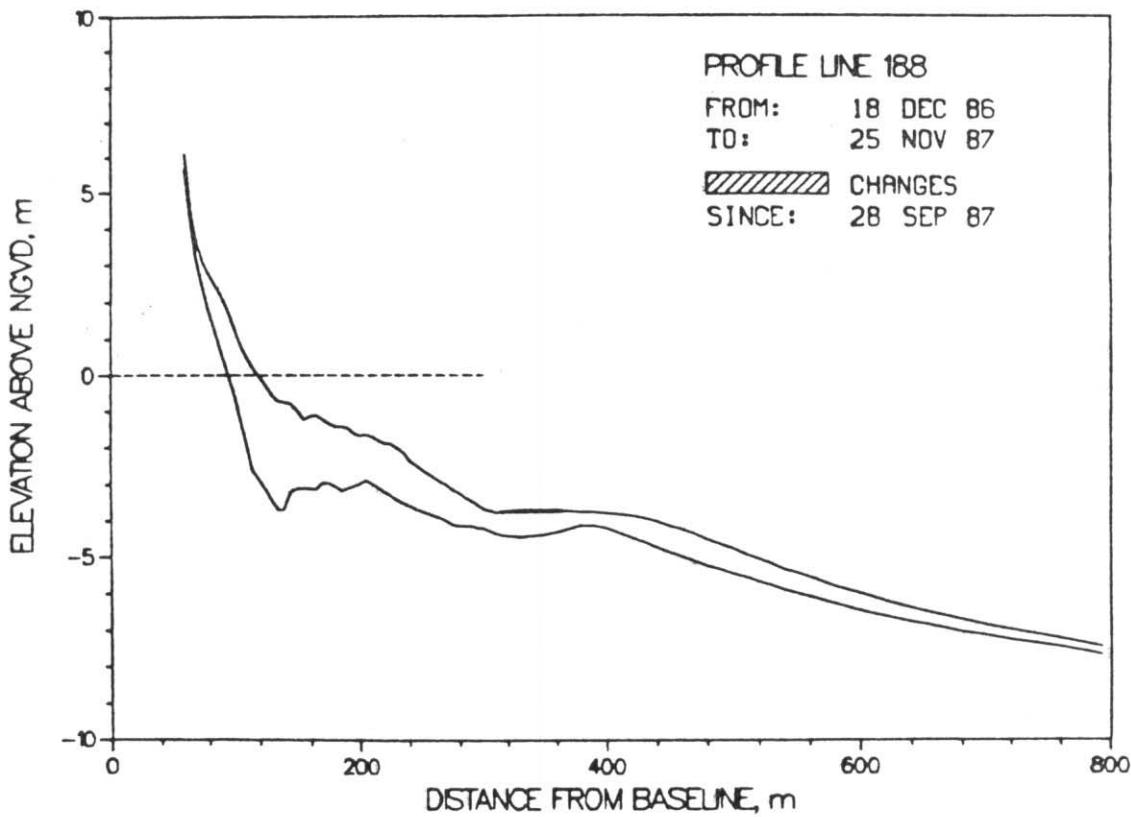


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. No bathymetric survey was conducted in November. The September bathymetry (Figure 7) is given for reference.

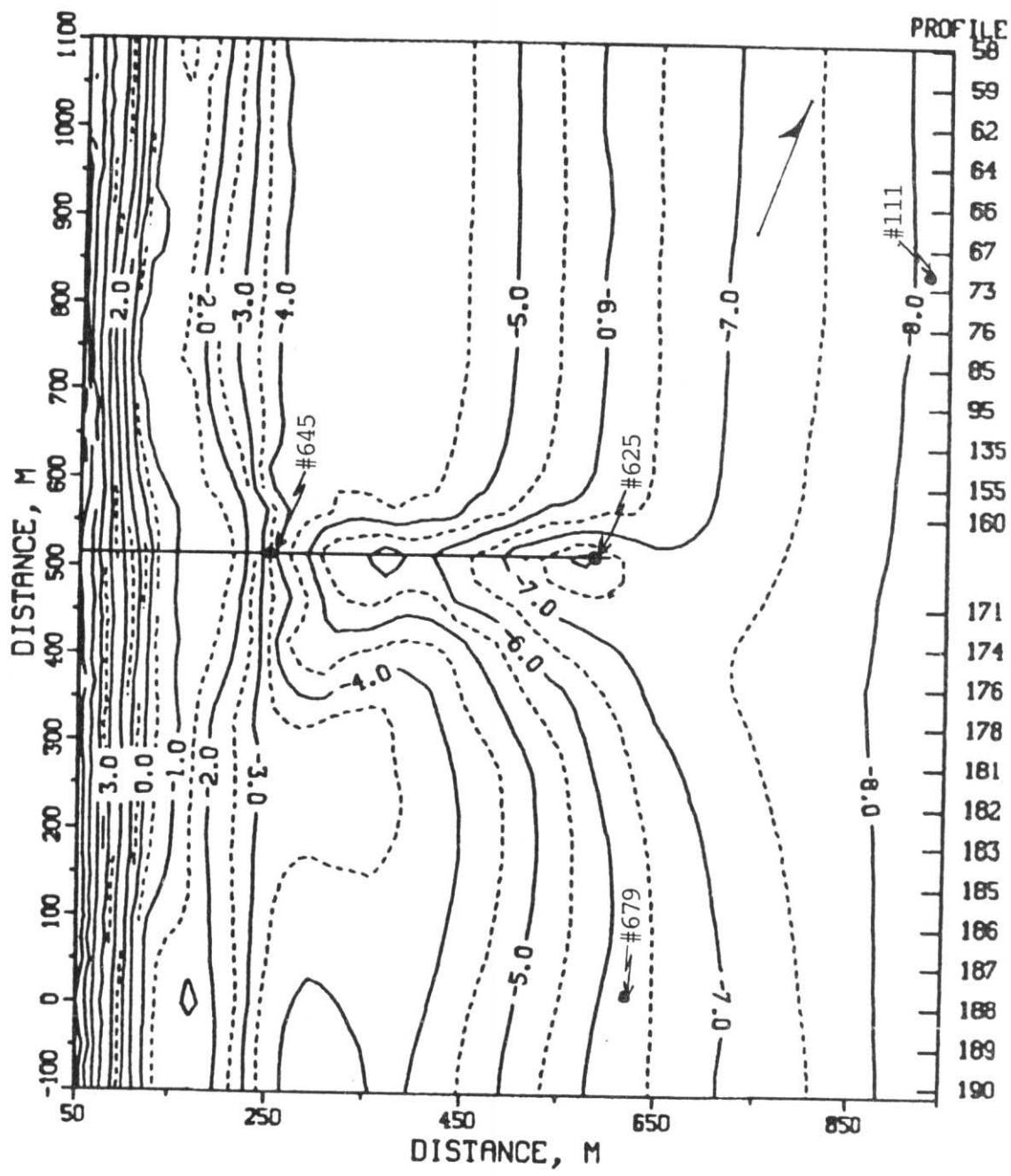


FIGURE 7. FRF BATHYMETRY 1 SEP 87
CONTOURS IN METERS

PART VIII: SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by Baylor Gage #625 at pier station 19+00) exceeded 2 m. When this occurred, four contiguous 34-min wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
11 Nov (2200)	12 Nov (1000)
27 Nov (1400)	27 Nov (2300)
29 Nov (1000)	29 Nov (2008)

B. Storm Synopsis.

11-12 November - On 9 November, this storm developed off the Texas coast, moved rapidly to the northeast, and by 11 November, was located off the Virginia coast. The storm intensified and continued its rapid movement up the east coast, reaching New England on 12 November. Maximum onshore winds (from the east) exceeded 13 m/s at 2200 hrs on 11 November; maximum H_{mo} of 2.39 m ($T_p = 10.67$ sec) occurred at 0400 hrs on 12 November. The lowest barometric pressure, 1007.2 mb, was recorded on 10 November at 1634 hrs. Total precipitation was 11 mm.

27-29 November - Winds caused by a strong Canadian high pressure system began to generate storm waves at the FRF on 27 November. The additional development of a storm over Tennessee and its movement to the North Carolina coast on 29 November prolonged the onshore winds through 30 November. The maximum H_{mo} of 2.3 m ($T_p = 10.24$ sec) occurred on 29 November at 1300 hrs. Maximum onshore winds (from the northeast) approaching 12 m/s were recorded at 1900 hrs on the 27th. The lowest barometric pressure was 998.9 mb on 30 November at 1442 hrs. Total precipitation was 34 mm.

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